

January 26, 2009

**Particle Data Group Advisory Committee
2008 Review Report**

PDG Advisory Committee Meeting, CERN, October 11-12, 2008

Executive Summary

The Particle Data Group (PDG) Advisory Committee met at CERN on October 11-12, 2008 to review the status and activities of the PDG.

The committee congratulates the PDG on the successful completion of 2008 Review of Particle Physics (RPP) and appreciates the PDG's great effort to keep the physical size of the RPP reasonable.

Given the recent growth of the data influx and the anticipated growth after LHC turns on, and given the growth of the PDG collaboration itself, the committee thinks that an evolution towards a better-structured, success-oriented and adequately staffed project management is strongly advisable. An increase in delegation of duties of the PDG Head seems prudent and would also contribute to the training of the next-generation senior management.

The committee is delighted to learn that the first phase of the computing facilities upgrade, completed in time for the 2006 edition of the PDG products, was used again successfully for the 2008 version. The PDG has completed a detailed description of tasks of the second phase. The committee endorses the PDG's plan and supports the PDG's request for additional human resources.

Triggered by the growing importance of the Reviews, the committee recommends that an improved procedure similar to that for updating the particle listings be defined for updating the Reviews. This could include appointing a diverse committee to act as a "Review Editorial Board" which evaluates the reviews as a collective body of work. The committee also has a number of specific recommendations for improving individual Review articles.

The rest of this report is organized as follows: 1) Introduction, 2) Project Management Issues, 3) Status of the Computing Facilities Upgrade, 4) Setting Up the Review Editorial Board, and 5) Specific Recommendations on Review Articles.

1. Introduction

The committee met at CERN on October 11 -12, 2008 to review status and activities of the PDG. The membership of this committee was:

Hiroaki Aihara (University of Tokyo)
Gustaaf Brooijmans (Columbia University)
Deborah Harris (Fermilab)
Patrick Janot (CERN)
Gilad Perez (SUNY, Stony Brook)

On the first day the committee heard 27 excellent presentations by the PDG collaboration. In the executive session the committee was joined by Stewart Loken, representing the LBNL Physics Division Directorate. The committee would like to express great appreciation to the members of the PDG collaboration for providing us a complete and detailed overviews of the PDG activities, Michael Barnett, the head of the PDG, for preparing the perfect setting for the meeting, and Stewart Loken for explaining the context of the PDG group at LBNL. We note the location chosen for this

particular review committee was appropriate, given many of the PDG members are now spending a significant fraction of their time working on LHC experiments at CERN.

The committee would like to congratulate the PDG on the successful completion of 2008 Review of Particle Physics (RPP). The quality of the work is excellent, meeting the community's ever-growing expectations. The committee appreciates the PDG's great effort to limit the physical size of the RPP to retain its ease of use. The committee also notes that the PDG has successfully followed most of the recommendations of the 2006 advisory committee. The committee learned that the first DOE review of the PDG was completed successfully and reaffirmed that the PDG is a great asset to the high energy physics community.

One of the issues at the previous advisory committee meeting was the readiness of the PDG in the LHC era. We endorse the computing upgrade plan with great enthusiasm. We recommend that the Physics Division further support the PDG in terms of human and computing resources.

Given the recent and anticipated growth of the data influx, and given the growth of the collaboration itself, we think the management of the PDG collaboration needs to be better supported and better structured. Given the PDG's high level of recognition by DOE as evidenced by the recent review in Germantown, now would be a good time to better structure the PDG management

We agree that it is important and practical for the PDG to work with experimental working groups like the Heavy Flavor Averaging Group (HFAG). We encourage even closer collaboration with those groups.

The following sections describe the recommendations of this committee in more detail.

2. Project Management Issues

The RPP has been, and still is, a tremendous success in the High-Energy Physics community, thanks to the hard work of the worldwide Particle Data Group (PDG) and the dedication of a handful of scientists at Lawrence Berkeley National Laboratory (LBNL). Because of this success and the large number of new measurements, the community's expectations continue to grow for each edition of the RPP.

To cover the demand and keep up with technological evolution, an upgrade of the computing facilities was proposed a few years ago and is now well engaged. The size of the worldwide PDG, which also naturally increases with this demand, has now grown to 170 authors (with most working a small part of their time for the RPP), and is similar to the size of a modern high-energy-physics experiment. The management of (technical and human) resources has, however, not yet followed the same upgrade path towards modern project management techniques, which are well-suited to managing large international collaborations. The central organization is solely concentrated in LBNL, and the responsibilities/duties of each of the few scientists of the LBNL group are immense.

The head of the PDG must, for example, coordinate ten listings, coordinate and edit fifteen reviews, oversee every aspect of production and operation, handle all budget matters, master relations with CERN, Japan, Russia, SLAC, etc., handle the entire bidding process of communication (with the corresponding hundreds of e-mails), lead the choice of new collaborators, organize meetings and reviews, and make sure that the overall project stays on schedule.

The gradual increase in scope of the RPP has multiplied the load for each task, and the committee is concerned that, because of the gradual nature of this evolution, the unavoidable impacts on the RPP are not immediately obvious. For example, there is probably a correlation between this evolution and the prolonged delivery time of the

final products to the community. In the longer term, the project could well be put in jeopardy, should this trend be left unattended. While a reinforcement of the core team in LBNL (including the replacement of the still active retirees) would overcome part of this risk and is strongly supported by the advisory committee, an evolution towards a better-structured, success-oriented and adequately staffed project management is viewed by the committee as advisable to ensure the long-term durability of the project. The committee notes that such an evolution is also critical in the light of the recent review of the PDG activities by the DOE.

With the advent of the new computing structure, accessible through the web over the planet, it becomes possible, hence advisable, to delegate and outsource large parts of the practical organization, in close collaboration with the core team in LBNL (as has been the case for years with, e.g., either the meson team or the organization of the neutrino section of the RPP.) To help in this endeavor, an organizational chart showing clearly the new lines of responsibility should be established and kept readily accessible.

The Level-1 management (a.k.a. spokesperson) would remain the duty of the PDG Head, but an increase in delegation of duties, together with an improvement in the tracking of progress seems prudent. This move would also contribute to the active training of possible future spokespersons, who would presumably come from within the LBNL group.

Given the increase in material for the RPP, and the limited increase in human resources made available to the PDG through the DOE, the committee also suggests that more pro-activity with outside institutions (CERN, FNAL, KEK, SLAC...) would be desirable. For example, the PDG should understand if and how outside institutions could hire people on their sites in positions partially dedicated to PDG organization. This suggestion is particularly relevant for CERN, where a huge amount of new data will soon be available, but is equally needed in other laboratories if the

aforementioned outsourcing is to become a reality.

To this end, the committee strongly suggests that a memorandum of understanding (MoU) be written as soon as possible, to define the current responsibilities of each and everyone in the PDG International Collaboration, to define the present relationship between the LBNL group and each of the external teams, and to sketch out a plan for a project management upgrade, as outlined above.

3. Status of Computing Facilities Upgrade

The first phase of the computing facilities upgrade was completed in time for the 2006 edition of the PDG products and used again for the 2008 version. This phase consisted of moving to modern hardware and a corresponding modern operating system (linux), re-implementing the database interface for editing and viewing, and providing the first version of the encoder interface. In addition to alleviating fears of a breakdown of the PDG due to computing issues, the production of two PDG editions has proven this system to be reliable and effective.

However, two years ago there were already concerns regarding the long term maintainability and documentation of some of the software that had been developed in this first phase, and the PDG had proposed a second phase in which the relevant components would be re-written using industry-standard tools. The advisory committee endorsed this plan and supported the PDG's request for additional human resources to pursue this. In the past two years, the PDG has worked on developing a much more precise description of the second phase. A detailed list of tasks with time estimates for completion exists. The total adds to four FTE-years, to be completed by two people in two years. As for all software projects, a significant contingency should be included, and the committee recommends a 50% contingency, as proposed during the DOE review, to provide an adequate margin. The committee was delighted to learn that this detailed plan has been approved by both the DOE and LBNL management

and is expected to be funded.

The committee learned that there is a temporary shortage of funds in March 2009. The committee views that maintaining the Computing upgrade at full strength without losing momentum is most beneficial to the community. We, therefore, urge that Physics Division of LBNL take proper action not to lose human resources of the PDG during this critical period. The committee highly appreciates the strong, continuing support to the PDG provided by the Physics Division and encourages even more pro-active support to the PDG.

It should be noted that in this second phase, a number of essential new tools will also be developed. These will vastly improve the PDG management's ability to track progress (currently done via email only), and will allow the many contributors to the PDG to encode, verify and review data without the need to interface through the main editor at every step. These tools are essential components to improve the oversight by management and reduce the risk of delays in the production of the RPP and other products.

The advisory committee was surprised to learn that pdgLive receives significantly less hits than there are downloads of the particle properties or reviews. Since pdgLive (or a future similar tool) appears to be the "way of the future" it would be good to understand why people make little use of it. It seems that a logical evolution using the tools developed during the second phase of the upgrade would be a downloadable version of pdgLive. A future survey should attempt to clarify users' knowledge and opinion of pdgLive.

4. Setting Up the Review Editorial Board

The committee notes that there is a well-defined systematic procedure for updating the particle listings with each new edition. This procedure involves a broad survey of a

set of refereed journals, assignment of articles to two appropriate readers, a review process and a well-defined averaging process where appropriate, and finally, content approval by each article's corresponding author.

If hits on the PDG web site are any indication, the reviews in PDG are at least as important as the listings themselves. The reviews comprehensively cover a large fraction of the theoretical and experimental issues at the frontier of particle physics research. They are typically written to give the reader the background to the specific topic. A short summary of the state of the art research on the subject, the relevant references and the most significant corresponding experimental measurements are given as well. The committee recommends that an improved procedure similar to that for updating the particle listings be defined for updating the reviews. This could include appointing a diverse committee to act as a "Review Editorial Board" which looks at the reviews as a collective body of work and evaluates:

- a) If the coverage in the reviews spans the field appropriately (for example if new topics should be added or others deleted).
- b) What the relative lengths of the different reviews should be. The purpose of a review is, the committee believes, to give a concise description for the state of the art of the subject with an appropriate set of references, not to provide an in-depth report of all aspects of a given subject.
- c) If the next review should be written by the current or a new set of authors to provide more even coverage of a given topic. We note that just as all physics categories in the particle listings have two readers/overseers, it would be best if all review articles had (at least) two authors from different backgrounds (theory/experiment, or two different experimental techniques).

Then, once the review topics, lengths, and authors were determined, the requests could

be submitted and the peer review process could follow as the reviews are entered into the database.

This "Review Editorial Board" could consist of members of the PDG (preferably not those who are writing review articles), members of the advisory committee, or a completely different group of people.

5. Specific Recommendations on Review Articles

The committee wishes to point out several articles that, based on the best judgment of its members, if revised, could provide more benefit to our community:

a) Dark matter and the linkage to astrophysics - possible annihilations of dark matter particles produce visible anomalous fluxes of various particles. In the past few years there has been rapid experimental progress on this frontier. Various experiments including DAMA, INTEGRAL, PAMELA, ATIC and WMAP (via the CMB haze) have already provided valuable data on this issue. Furthermore there is a set of new experiments that is expected to yield results in the coming months. Thus, we propose that the dark matter review would be revised including a more detailed discussion on the plethora of incoming measurements. Following the PDG's successful tradition, such review authors should include experts from theoretical and experimental particle physics and from observational astrophysics.

b) We reiterate the urgent need for a thoroughly revised QCD article. We also strongly advise that, in view of the coming LHC era, the new review include discussion of various jet finding algorithms.

c) Another issue that is not covered in the present edition is related to Monte-Carlo (MC) and event generators. In the last few years there was significant progress in the field which is reflected in a number of new generators and in the appearance of new

level of sophistication (such as several procedures of matching, and NLO MC tools such as MC@NLO). We propose that a short review on this subject will be added, to summarize the tools available in the field and the differences between the various approaches.

d) We are concerned about the length of some of the review articles. The size of the RPP is naturally growing and it is hard to see how the listings can be reduced. However, the reviews can be scrutinized so that they would maintain their high profile in term of handiness (they play a very different role than review journals such as Phys. Rep. etc.). As we have mentioned above, we leave the more systematic discussion of this issue to the future but we are concerned that this can become a serious problem in view of the beginning of the LHC era.

Specifically, we would like to point that between the 2006 and the 2008 editions the review article of the Higgs bosons has almost doubled its size, though this does not reflect any significant theoretical or experimental development. We recommend that the following edition should try to reduce the size of the Higgs section with the caveat that a discovery at LHC could change the scope of the Higgs section in the reviews. The same holds for the two SUSY review sections. The current versions make excellent treatises for the experts but may be more detail than is needed for the main purpose of these reviews.

e) We find the extra dimension section a bit too concise. In the recent years the phenomenological study of various extra dimension models have matured. The collider phenomenology of different frameworks was worked out in a fairly detailed fashion, in particular, that of a warped extra dimension. We therefore propose that some discussion of LHC collider phenomenology and the corresponding references be added. It might be useful to consider moving the warped extra dimension part from where it is now and combining it with the models of strong dynamics and compositeness since some of the phenomenology is very similar.

f) Given the increased interest in the field of neutrino oscillations, we recommend that PDG add a review article to cover accelerator-based neutrino oscillation experiments. We also recommend that PDG expand its coverage to include lower energy neutrino cross section measurements and formulae. Specifically, the neutrino-electron cross sections and quasi-elastic cross section formulae, and the total neutrino cross section measurements at low energies (100-3000 MeV) should be included.

g) The committee would like to point out that in the discussion about the NuTeV weak mixing result in Electroweak Physics Review by Erler and Langacker, the authors discuss the effect of the strange sea asymmetry on NuTeV's result, which makes the result more consistent with the Standard Model. They, however, do not mention another effect that is almost twice as important and moves the NuTeV result away from the Standard Model prediction. This effect is the new more precise measurement of the Ke3 branching ratio, which is older than the strange sea asymmetry measurement. Including both effects would change the conclusions of the review, and if the reader looks to this review as "the last word" on the weak mixing angle as measured by neutrinos, he or she is not getting the whole story.

Therefore, the committee recommends that when experimental results are modified in the reviews to be different from the published values, those modifications should be reviewed by the corresponding authors from the experiment. The committee also wishes to recommend that review articles that quote experimental results in a broader context be reviewed by the experiment's authors themselves, as part of the review process, to assure more balanced view of the results.

Appendix A: Summary of Recommendations

Project Management:

1. We recommend a reinforcement of the core team in LBNL, including the replacement of the still active retirees.
2. We recommend a better-structured, success-oriented and adequately staffed project management.
3. We recommend that the LBNL team delegate and outsource more of the practical organization, and we recommend that the tracking of progress be improved.
4. We recommend that an organizational chart showing clear lines of responsibility be explicitly kept available for the sake of better project management.
5. We recommend more pro-activity with outside institutions (CERN, FNAL, KEK, SLAC...) including the possibility of having dedicated PDG members on the staff of other laboratories.
6. We recommend that a memorandum of understanding (MoU) be written as soon as possible, to define the current responsibilities of each and everyone in the PDG International Collaboration.

Computing Upgrade:

1. We recommend that the PDG continue with the planned computing upgrade.

2. We recommend that Physics Division of LBNL take proper action not to lose human resources of the PDG in the period of March 2009.
3. We recommend that a future survey be done to clarify users' knowledge and opinion of pdgLive.

Review Articles:

1. We recommend that an improved procedure similar to that for updating the particle listings be defined for updating the reviews.
2. We have several specific recommendations concerning the PDG treatment of dark matter, QCD, Monte Carlo/event generators, the Higgs Boson, extra dimensions, and neutrino physics.